Inter-municipal Competition on Cape Cod

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Introduction:

Cape Cod consists of many neighboring towns, and the competition amongst these governments for residents (and thus, the recipient of his or her tax dollars) is substantial. Residents provide tax dollars and bring money to local businesses, and help the town maintain town goods such as water supply, public safety, public education, infrastructure, and conservation land. There are a number of different dimensions over which Cape Cod towns compete for residents, but the dimension I will focus on in my theoretical analysis is the beauty and quaintness of the town's physical appearance. Historical preservation is used by towns to maintain the appearance of an "Old Cape Cod" town: a beach village with historical buildings, small cottages and winding roads. The beauty of this historical style is a drawing point for people. Towns, hoping to lure residents manipulate the strictness of their zoning laws. Strict zoning laws are laws that strongly enforce historical preservation (and therefore maintain the town's unique beauty) but come with a convenience cost to the residents. As a town focuses more on historical preservation, residents must live with an increased number of constraints regarding how they can develop their home.

One may expect that given this competition for residents, all towns on Cape Cod would choose strict zoning laws, knowing that potential residents take pleasure in the historic charm. In reality, however, towns face different incentives to look beautiful, whether by historical preservation or environmental protection. One relevant factor that could influence a town's willingness to pass strict zoning laws is distance from major urban centers. The farther a town may be from the Cape Cod Canal, the harder that town might have to work to attract residents. This, in turn, would lead towns to focus more on historical preservation. In this way the farther town will provide an incentive for potential residents to live in its town rather than another town, which may be closer to the Cape Cod Canal. I will show in a theory model under certain circumstances, that as a town gets farther from the Cape Cod canal (and requires more time and money for people to reach) the more effort that town spends to emphasize its

historical preservation and beautification. Therefore, the distance of a town on Cape Cod from the Cape Cod Canal affects the type and extent of development of the town.

An example of this can be seen when comparing the towns of Hyannis and Chatham. Upon first crossing the Cape Cod Canal, one area you will soon reach is Hyannis, one of the villages of Barnstable. Among other things, Hyannis is home to the Cape Cod Mall, Cape Cod Hospital, Hyannis Airport, a Honda dealership, and substantial commercial and industrial enterprise businesses that involve large modern buildings, substantial infrastructure, and industrial suppliers. If any town is to be considered the business center of Cape Cod, it would be Hyannis. In contrast, farther from the Canal about midway up the Cape, is Chatham, a town with a reputation for its rejection of large chain commercial developments and retail stores and its dedication to historical aesthetic. In one incident several years ago, residents protested the opening of a Dunkin Donuts in the town, saying that the business would damage Chatham's public image. Despite the obvious differences in town appearance and specifically Chatham's greater efforts regarding historical preservation, both Chatham and Hyannis have been able to successfully market themselves as destinations for residents. The theoretical model I have created explores this relationship.

The zoning policies of Cape Cod towns demonstrate a concern with the preservation of its unique historical appearance. An example comes from the town of Yarmouth. Yarmouth's Architectural Design Standards states that "Yarmouth has many desirable aesthetic qualities and areas with unique character. These attributes have been closely guarded and nurtured...Despite this tradition, increasing development pressure for standardized and corporate driven design solutions threaten the very essence of what makes Yarmouth a desirable and unique place" (1). Provincetown has regulations regarding many aspects of public areas. For example, "shrubs or trees which die shall be replaced within one growing season" (45) and "architectural design shall be compatible with historic character and scale of buildings in the town" (45). This type of visual regulation extends to other aspects of the town, including signs. In addition to

limits on the size of a sign and the necessity of sign registration, a sign may only be put in place if "the benefit of [the sign] outweighs the adverse effects", the sign is "compatible with architectural style", "doesn't contribute to visual clutter", is "attractive and functional" and "does not cause traffic" (36). These regulations are an indication of the balance Cape Cod towns must maintain between making themselves beautiful and making themselves convenient and comfortable.

It is the assertion of this paper that the town's choice of how to balance charm and convenience depends upon its distance from the Cape Cod Canal, making it a more or less convenient place to reach. This relationship between distance and zoning laws is what this model tries to explain and predict. The fact that the visual image of Cape Cod towns are supported by statements in their zoning laws means that the model does predict an actual type of town competition which occurs in the real world.

Literature Review:

One common instrument used by governments competing with each other is zoning laws. In manipulating their zoning laws, towns are able to alter the public image of the town and therefore, the type and number of people living in there.

Fischel (1992) states that one reason in part for the success of zoning laws in creating efficient property taxation is in the ability of zoning laws to be designed for an intended effect upon a given community, and also the ability for most every community to engage in zoning at some level. Looking at various examples, he concludes that zoning is "permissive in small, rural jurisdictions in which the majority of voters are farmers or people otherwise allied with owners of undeveloped parcels, who do not want the disposal of their major assets constrained by regulations" (174). Fischel also quotes his own monograph *Do Growth Controls Matter?* (1990) in support, saying that in studies where economists have concluded that zoning is not effective are usually those studies that use data from urban communities, where zoning policy is often affected by political incentives. Additionally, Fischel points out a common mistake many economists fall victim to when analyzing zoning in different communities: instead of

analyzing zoning laws with respect to lot size, they should instead be analyzed as “barriers” put up by the community to control developers.

One example of towns using zoning laws to manipulate their physical and human makeup is considered in Lutz (2015). This paper studies how changes in property taxes of an area, zoning laws, and housing supply elasticity affect the construction of new homes, using a change in tax law in New Hampshire as the basis for its analysis. The paper finds that housing construction spikes in response to a shock in property taxes but only in areas farther from Boston, suggesting that the housing supply is more elastic as the distance from the city increases, potentially due to the greater area of land undeveloped as you get farther from Boston. This means that rural governments have an ability to alter the constituent make-up, and thus who is paying the jurisdiction’s taxes: if property taxes are greater, wealthier people will be buying homes in that town. Thus, if towns can incentivize wealthy people to live in their jurisdiction, they will be able to collect more money in taxes.

McMillen and McDonald (2002) examine the effects of zoning policy on a community and its potential effectiveness. The focus of their analysis is on the introduction of a zoning law which was enacted in Chicago in 1923. Using a model involving the land value of commercial and residential land, the authors found that land value was affected by the new zoning law, indicating that zoning can be used to manipulate the value and thus desirability of town property. Following the introduction of the zoning law, the value of residential land increased, while the value of land that was previously used for both commercial and residential purposes saw no change in land value.

Another example of zoning regulations affecting a community’s development is the case of Glaeser and Gyourko (2002). Glaeser and Gyourko (2002) study a government’s ability to alter housing construction through their investigation of whether or not the United States is suffering from an affordable housing crisis. They come to the conclusion that zoning and land use controls are the main cause for the increase in housing prices. Specifically, “measures of zoning strictness are highly correlated with high

prices" (21). Among other examples of such regulations, the time and effort it takes to get a building permit is one factor they found which causes the increase in housing construction (and therefore housing costs and value) in given areas. The increased expense of houses means that they are more likely to attract a population with a higher average income.

While there is evidence that zoning is effective and beneficial in altering a community's development, McDonald (1995) comes to the opposite conclusion in analyzing Houston's decision (by vote) to remain without zoning laws. Percentage-wise, upper and middle classes in Houston have much higher support for zoning laws. This supports the opponents of zoning because it indicates that zoning fosters segregation and corruption, and is used as a vehicle to keep the lower class out of otherwise wealthy neighborhoods.

There has also been prior theoretical models made regarding inter-jurisdictional competition to attract constituents using zoning laws. Hamilton (1976) creates a model comparing the prices of High Income Housing (HIH) and Low Income Housing (LIH) within a group of communities. In determining the eventual prices of each of these units, the author assumed the cost of land was the same across all units; the only cost to go from LIH to HIH was that of "the resource differential". One significant conclusion the author asserts is that "once the supplies of the various bundles of housing plus public service are given, the price of each bundle is determined solely by demand" (751). Additionally, the author goes on to explain that the influence of the property tax of an area is instead "in the supply of the bundles" of housing and public service. Another significant result the author derives from his model is that "with a proportional property tax, a free market will generate an oversupply of low income housing, and some form of control such as zoning is necessary to restore efficiency" (752). Mills (1989) is another theoretical model of zoning; however, this study takes a negative view of zoning, arguing that though it may aim to help a community develop, it is in reality suboptimal due to the social costs it creates, including "municipal exactions" and "resource consuming procedures for rationing zoning rights" (5). In

order for zoning to be effective, this paper argues that additional action must be taken along with the introduction of zoning laws to avoid land rents.

Competition between different entities has also been modelled with respect to situations other than between governments. While not directly about intergovernmental competition, the model of this paper most directly relates to Groseclose (2010). Groseclose (2010) models elections involving 2 candidates taking into account each candidate's platform. Groseclose analyzes how a candidate's chosen platform depends upon his or her valence advantage, a term referring to an advantage which is innate or given (for example, a candidate's 'likeability'). Groseclose argues that a candidate with a valence advantage will still adopt a platform different from his ideal platform in order to capture not only the votes of his most devoted supporters but also those voters whose policy ideal lies in between his platform and his opponents, increasing his likelihood of winning the election. As a result of this, the candidate without the valence advantage will adjust his policy so that it is more extreme, hoping to secure those voters who are strongly supportive of his ideals.

The model also accounts for changes in each candidate's platform as a result of the degree to which each candidate values the office he is running for versus the degree in which he values maintaining his ideal platform. This is done by weighting the utility derived from winning the election versus the utility gained from maintaining a platform near the ideal.

Groseclose concludes that "when a candidate has a small but positive valence advantage, this causes him or her to move toward the center" and "a valence disadvantage causes a candidate to move away from the center" (876).

Construction of the Model:

This is a model of competition amongst towns on Cape Cod. The goal of this model is to determine whether a town's location relative to the Cape Cod Canal influences its choices regarding the stringency of its zoning laws.

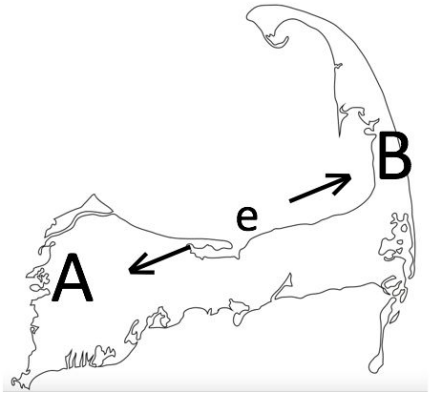
When zoning laws are stringent in a town, development is highly controlled and regulated. This makes the town remain relatively unchanged throughout the years with respect to its architecture and style. For towns on Cape Cod, stringent zoning laws mean the "Old Cape Cod Style" is preserved. These zoning laws prevent the destruction of small Cape buildings and landmarks by limiting what can be done to alter old buildings, and what can be newly constructed in the place of old buildings. Other zoning laws restrain construction of parking lots, and highways. The preservation of the town's historical image make the town "quainter" and "rustic". People find the town a beautiful place to live.

When zoning laws are less restrictive, the town is better able to develop and adapt to modern life. For towns on Cape Cod, this means that bigger buildings can be built and downtown areas can develop into modern shopping plazas. When this happens, the historical nature of the town is not preserved. The town is less "quaint" and "rustic" than the town with stricter zoning laws. Despite this, the people living in the less restrictive Cape town enjoy a more convenient lifestyle: parking lots are not limited, transportation is very available, and buildings can be constructed and altered as needed for commerce and housing.

Thus, there is a trade-off Cape Cod towns must consider when implementing zoning laws. Strict zoning laws lead to the preservation of a historical style unique to Cape Cod, making the town beautiful charms. Less restrictive zoning laws leads to traditional buildings and infrastructure being replaced by a homogenous modern style can be detrimental to the town's unique beauty, yet give the town's residents a more convenient lifestyle. I will model this tradeoff analytically.

Assume there are two towns, town A and town B, both on Cape Cod. Each town is a fixed distance from the Cape Cod Canal, which separates Cape Cod from the rest of Massachusetts, and, in particular, the more urbanized Boston suburbs. Town A is assumed to be right next to the Cape Cod Canal, so it has a distance of 0 from the border. Town B's distance from the Cape Cod Canal is denoted as

e, where e ≥ 0. Distance from town B to Cape Cod is a parameter allowing me to analyze how the distance from the town to the Canal affects the town's choices regarding the stringency of its zoning laws.



Each town is also endowed with an ideal balance of charm level (historic preservation) versus convenience level (how easy it is to live there). Create a scale of charm versus convenience.

0 - - - - - - - - - - - - - .5 - - - - - - - - - - - - - -1

This scale goes from 0 to 1, where 0 is a town which has the highest level of convenience for its residents but has no charm, but 1 is a town which has the highest level of charm, but is inconvenient for the life of its residents. A town at .5 is a town which is halfway between having the highest level of charm and being the most convenient. Because this scale of charm describes the extent to which a town maintains its level of "rustic-ness", let the value of any town on this scale be called that town's level of "Rustic Charm". Let town A's ideal point on this scale be denoted as a*, and town B's ideal point is denoted as b*.

Each town has one policy tool at its disposal: the stringency of its zoning laws. Each town will choose this stringency to maximize an objective function that itself is a weighted average of two components. The first component is that each town values having more residents want to live within its borders. The second component is that each town values a level of Rustic Charm that is close to its ideal point on the Rustic Charm scale. I assume that each level of Rustic Charm is associated with a unique strictness of zoning law. So, we can model the town's policy instrument as its level of Rustic Charm

directly instead of using the intermediary of zoning law. The combination of these two components creates the total value each town's utility.

Putting these two components together, the overall function for town A and town B are composed as:

$$Ua = (Na)*(\lambda) - (1-\lambda)*(a*-a)^2$$

for town A, and

$$Ub = (Nb)*(\lambda) - (1-\lambda)*(b*-b)^2$$

for town B.

In the utility functions, the parameter λ measures how much towns value residents versus getting its actual charm to match its ideal charm. When $\lambda = 0$, each town values only how close its actual charm matches its ideal level of charm. When $\lambda = 1$, each town values only having more citizens. Additionally Na is the percentage of residents in town A, and Nb is the percentage of people in town B. It will always be true that $Na + Nb = 1$.

Before moving explaining the residents' objectives, it is necessary to first understand the town's underlying preferences. For any value of Na and Nb, the value enjoyed by the town as a result of these residents depends on the value of λ. When λ is large, then for any value of Na and Nb, each town finds greater value in having a larger number of residents than in the case were λ is small. So, the first component of each town's function is represented as $(Na)*(\lambda)$ for town A, and $(Nb)*(\lambda)$ for town B. The values of $(Na)*(\lambda)$ and $(Nb)*(\lambda)$ are the values which town A and town B derives from the people who live in its borders.

Now consider the second component, that each town values a zoning law close to its ideal point on the Rustic Charm scale. A town uses its zoning laws to alter its level of Rustic Charm. Zoning laws are the tool with which a town uses in order to adjust its physical appearance. As a town's zoning laws

become more stringent, the Rustic Charm of the town increases. As a town's zoning laws are relaxed, the Rustic Charm of the town decreases. Thus, there is a one-to-one correspondence between a town's zoning laws and a town's level of Rustic Charm. The more deviant a town's zoning laws are from the town's ideal zoning laws, the more detrimental the zoning laws are to the town itself. So, as the difference between the ideal zoning laws and the implemented zoning laws increases, the resulting cost born by the town also increases. The size of this cost is also contingent on the value for towns of maintaining a zoning law close to its ideal point, 1-λ. For any given difference between ideal and actual zoning laws, the larger the value of 1-λ means a greater cost to the town as a result of the difference in zoning laws. Let the actual implemented zoning law in town A be denoted by a, and the actual implemented zoning law of town B be denoted by b. Then, the second component of the town's overall function is denoted as $-(1-\lambda)*(a^*-a)^2$ for town A, and $-(1-\lambda)*(b^*-b)^2$ for town B. These expressions for town A and town B are the cost which town A and town B incur for any given stringency of zoning law.

The second type of agents in this model are residents. Residents choose which town they will live in (town A or town B) by picking the town which will provide for them the best quality of life. Residents consider two factors when picking which town to live in: how convenient the town is to reach (how close it is to the Cape Cod Canal) and how close the town's level of Rustic Charm is to their ideal Rustic Charm.

I assume that residents are unique in that each resident has a unique desired level of charm versus convenience. Let a particular resident's ideal value be v, where $0 \leq v \leq 1$. So, if $v = 0$, that particular resident wants to live in an environment which is as convenient as possible. He does not care about charm at all. Similarly, if $v = 1$, then that resident wants to live in an environment which is as charming as possible, and has no concern for convenience of the town in which he lives. Further, assume that there is a continuum of these individuals and that the v for each of these residents are distributed based on a uniform distribution from 0 to 1. The median resident, therefore, has a value of $v = ½$. Every resident has

a unique value on this scale, and let this value be represented as v. This value is a resident's ideal level of Rustic Charm. The larger the difference between the resident's preferred level of charm versus convenience and the town's level of charm versus convenience, the less benefit that resident will derive living in that town.

A resident's benefit living in a Cape Cod town also depends upon how close the town is to the Cape Cod Canal. Town A was on the border, so this proximity comes with no disutility. However, town B is distant from the border. Because of this, e, the value of the distance from town B to the Cape Cod Canal, is subtracted from town B. Putting both parts of the equation together, any resident's benefit from living in town A is:

$$-(v - a)^2.$$

Similarly, the benefit from living in town B is represented as:

$$-(v - b)^2 - e$$

To determine how many residents each town will have, it is necessary to determine the indifferent resident, the resident who will be equally happy living in town A or town B because they receive the same benefit from living in either town. The indifferent resident's value of v is the value where:

$$-(\triangledown - a)^2 = -(\triangledown - b)^2 - e.$$

The value of v where the benefit from living in town A or town B is equal. This is equivalent to:

$$(½)*((a^2 - b^2 - e)/(a - b)) = \triangledown$$

Let this value of v, the value of v for the indifferent resident, be denoted as $\triangledown$. The resident with a value of v equal to the above equation, $\triangledown$, is indifferent to living in town A or town B.

For given values of a and b, each town's population can now be determined. Whichever town provides the greater benefit for the resident with the value of v = 0 will get all the resident with a value of $\triangledown$ less than the indifferent resident. These people with a value of v less than the indifferent resident will pick the same town to live in as the resident with a value of v=0 because all individuals with a value of v

less than the indifferent resident will derive greater utility from the same town. By the same reasoning, all residents who have a value of v greater than the indifferent resident will go to the other town. Therefore, one town will have a population of ∇, and one town will have a population of 1-∇.

This model uses Matlab to solve for the Nash Equilibrium level of Rustic Charm of town A and town B given values of λ, a*, b*, and e. It does this by first finding town B's optimal response level of Rustic Charm given every possible value of town A's Rustic Charm (all possible values of a). For each of these optimal responses of town B, the program then checks if town A is at its optimal response given what town B is doing. The program calculates the utility of town A, Ua, for all levels of Rustic Charm given town B's level of Rustic Charm to verify that town A is optimally responding to town B.

Results:

In all of these cases, it should be noted that the values of a* and b* were the same throughout all subcases as a standard to make it as relevant as possible to compare cases. I assume that the value of a* = ⅓, and the value of b* = ⅔. This can also be seen on the tables displaying the results.

1. Subcase 1: **λ=0, e=0**

In this case, let's assume that each town is located right on the border (e=0) and that each town only cares about their level of Rustic Charm (λ=0). In this case, each town values only choosing a zoning law as close as possible to its ideal point of Rustic Charm and does not value the number of residents who live in its borders, so each town chooses a zoning law equal to its ideal zoning law. Therefore, there is a Nash Equilibrium where each town chooses a level or Rustic Charm which is equal to their ideal level of Rustic Charm: so a=a* for town A, and b=b* for town B. Given these choices, the town that happened to be endowed with an ideal point closer to the median residents preferences will attract more people to live within its borders. If either town were to pick a level of Rustic Charm different from this ideal level, this would decrease their level of Rustic Charm because they only derive utility from maintaining their ideal level of Rustic Charm.

Proposition: The Nash Equilibrium in this case is where both towns choose to maintain a stringency of zoning law equal to their ideal point, a level of Rustic Charm where a=a* and b=b*. The resulting utility in this case is zero for both towns.

Proof: To prove that the Nash Equilibrium is the point where a=a* and b=b*, it must be shown that neither town has an incentive to deviate from this value. To do this, it is necessary to show that a deviation by either town from the values in this equilibrium lead to a decrease in that town's welfare. Because in this case town A and town B are identical except in their ideal level of Rustic Charm, it is without loss of generality to assume that town B chooses a stringency of zoning law b, where $b \neq b^*$. In this case, the difference between b and b*, $|b^*-b| \neq 0$. This would decrease the utility of town B: because $Ub = (Nb)^*(\lambda) - (1-\lambda)^*(b^*-b)^2$, if the value of $|b^*-b|$ increases, the value of U(b) decreases. Therefore, town B will not deviate and choose the value of b where $b^* \neq b$. Consequently, the Nash Equilibrium is b=b* and a=a*.

2. Subcase 2: **λ=1, e=0**

In this case neither town has a distance advantage over the other, as both towns are located right on the border of the Cape Cod Canal. Additionally, both towns only value gaining the maximum number of residents possible. They do not at all value choosing a zoning law which is close to their ideal zoning law. Instead, they only value choosing a zoning law which will result in them gaining the maximum number of residents possible. This means that each town considers only how its choice of zoning law is viewed by possible residents. Towns in this case shape their zoning laws with the goal of making themselves as attractive to as many residents as possible. The result in this case is that there will be a Nash Equilibrium where both town A and town B maintain a level of Rustic Charm of .5. This stringency of zoning law is halfway between the most stringent of zoning laws valuing solely charm (which would be a level of Rustic Charm of 1) and the least stringent of zoning laws valuing only convenience (which would be a level of Rustic Charm of 0), and matches the ideal point of the median resident. If both town

A and town B are at a Rustic Charm of .5, they have maximized the payoff they can get, there is no incentive for either town to move. If town A changes its Rustic Charm to a level below .5, then its Rustic Charm will decrease because the ideal Rustic Charm of the indifferent resident has decreased, and the town with the lower Rustic Charm will get all of the residents to the left of the indifferent resident's ideal Rustic Charm. Therefore, town A will not move to a lower level of Rustic Charm.

Similarly, town A will not move to a level of Rustic Charm above .5. This is because doing this will increase the ideal level of Rustic Charm of the indifferent resident, leading to a decrease in the number of residents town A gets and also a decrease in town A's total payoff. Therefore, town A will not move to a higher level of Rustic Charm. By the same reasoning, the same can be said for town B.

Proposition: The Nash Equilibrium in this case is where both towns choose to maintain a level of Rustic Charm of .5. This is a stringency of zoning law equal to the preferences of the median resident: halfway between valuing solely convenience and valuing solely charm. The resulting utility is that both towns get a utility of .5.

Proof: To prove that the Nash Equilibrium point a=b=.5, assume that a town chooses a value different than the equilibrium value. Because town A and town B differ only in their ideal level of Rustic Charm, without loss of generality it can be assumed that town B decided to maintain a level of Rustic Charm b>.5 in an attempt to gain more residents by making itself more attractive. Now, town A and town B are identical in their ease to reach, only town B has a greater level of Rustic Charm than town A. Looking at the equation of the indifferent resident, (½)*((e - a + b)/(b - a)) = ▽, this value is now larger, so town B now receives fewer residents than town A. The same is true for when town B has a Rustic Charm of < .5. This decreases the indifferent resident's ideal level of Rustic Charm, decreasing the number of residents town B will receive. This cannot be a Nash Equilibrium, because in this case towns only gain utility from gaining residents.

3. Subcase 3: **λ=1, e>0**

This is the case where town A and town B only value gaining residents and thus cater the stringency of their zoning laws to the preferences of individuals. When deciding their point of Rustic Charm, they do not consider the relationship between their ideal point of Rustic Charm and the point of Rustic Charm they actually enforce. Additionally, town B is farther from the Cape Cod canal than town A. That is, town A is sharing a border with the Cape Cod Canal, and town B is farther up the arm of Cape Cod, away from the Canal. This means that any resident who wishes to go to town B must travel a farther distance than a resident who wishes to go to town A. Town B is therefore more time consuming and costly to reach than town A.

Let's understand the logic here, starting with town A. There will be no Nash Equilibrium in this case. This is because town A can guarantee that it gets all residents if it mimics town B's choice of Rustic Charm, or zoning law, exactly. Town A and town B are identical, except for the fact that town B requires more effort to reach than town A. If town A has the same stringency of zoning law as town B, then town A has eliminated any incentive for a resident to choose town B over town A. This means that town A would get all of the residents; town A is identical to town B, and is cheaper and quicker to reach. Town B does not like this outcome because it gets no residents. This means that town B will want to distinguish itself from town A in an effort to lure in some fraction of residents. Because town A and town B have opposing goals for their level of Rustic Charm, there is no Nash Equilibrium.

Proposition: In this case there is no Nash Equilibrium. Town A will attempt to mimic town B's level of Rustic Charm. If it succeeds, it will gain all of the residents maximizing its welfare. Town B will want to have a different Rustic Charm than town A, so that it may provide an incentive for residents to bypass town A and travel a longer distance necessary to reach it. The contradictory nature of these goals leads to the impossibility of a Nash Equilibrium in this case.

Proof: If town A is successful in maintaining the same level of Rustic Charm as town B, then for every resident, $(v-b)^2 - e < (v-a)^2$, so every resident will pick town A over town B. Because in this case towns

only derive utility from gaining residents, this means that town A will get a utility of U(a)=1, and town B a utility of U(b)=0. This cannot be a Nash Equilibrium.

If town B can choose b≠a, then town B will be able to gain some residents, U(b)>0. However, this means that the utility of town A decreases so that U(a)<1. Therefore, this is not a Nash Equilibrium. Town A will not choose a level of Rustic Charm that is less than the level of Rustic Charm of town B.

4. Subcase 4: **$0<\lambda<1$, e=0**

In this case, town A and town B are both bordering the Cape Cod Canal. Because $0<\lambda<1$, both towns derive a fraction of their utility from gaining residents (λ) and a fraction of their utility from maintaining a level of Rustic Charm near their ideal level of Rustic Charm ($1-\lambda$).

There exists a trade-off for towns when choosing a level of Rustic Charm, a level of stringency for zoning laws. As a town alters its level of Rustic Charm, changing its zoning laws to more closely match the median resident and thus gain more residents, the town suffers a cost of deviating from its ideal level of zoning law. Not deviating from their ideal zoning laws and instead keeping their level of Rustic Charm at the most ideal point also bears a cost for the town. By not changing zoning laws, a town suffers from a lower number of residents. Thus, in this case both towns must weigh the relative costs and benefits of each stringency level to decide the most beneficial level at which to operate.

In this case, at small levels of λ there will be a Nash Equilibrium where both towns maintain a level of Rustic Charm a small amount closer to the median resident. A small value of λ means that towns value their ideal zoning law more than getting more residents to live in their town. So, at a small value of λ towns will change their zoning laws somewhat towards the ideal zoning law of the median resident, until the convenience cost of altering their zoning laws is greater than the value of the additional residents the town gains in changing their zoning laws. Because λ is small, towns will only change their Rustic Charm a small amount to attract more residents. The gain in benefit from the increase in residents will quickly become overridden by the negative impact towns face as a result from changing their zoning laws.

As λ grows larger, towns slowly care more about gaining people and less about their level of Rustic Charm. As a result of this, each town begins to adjust its zoning laws so that its level of Rustic Charm moves towards .5, each trying to push the value of the indifferent resident away from the town's ideal level of Rustic Charm so that more residents will choose it over the other town.

Once λ gets large enough, the benefit of having a zoning law equal to the ideal zoning law of the median resident is greater than benefit of maintaining any other level of Rustic Charm. Any deviation in Rustic Charm in an attempt to make its zoning law closer to its ideal zoning law will cost the town more in loss of residents than it gains by changing its zoning law to be closer to the ideal. The Nash Equilibrium will be at the point a=b=.5, the level of Rustic Charm of the median person. This point is halfway between a level of Rustic Charm of 0, the least restrictive level of zoning law, and a level of Rustic Charm of 1, the most stringent level of zoning law.

Proposition: In this case:

I. At small values of λ, the Nash Equilibrium is at a point where both towns change their zoning laws a small amount, moving somewhat closer to the median resident's ideal value of v, but largely remaining tied to the town's own ideal value of a* or b*.

II. As λ increases, the level of Rustic Charm at the Nash Equilibrium converges to the point a=b=.5, where .5 is the median person's ideal level of zoning law.

Proof:

I. Because in this case $0 < \lambda < 1$, towns derive utility from both gaining residents and maintaining a level of Rustic Charm close to their ideal. For example, looking at the utility function of town A: $Ua = (Na)*(\lambda) - (1-\lambda)*(a^*-a)^2$, both $(Na)*(\lambda)$ (utility from gaining more residents) and $- (1-\lambda)*(a^*-a)^2$ (utility from maintaining an ideal level of Rustic Charm) are providing utility for the town. When λ is small, town A derives a small amount of utility from gaining more residents, and a greater amount of utility from the level of Rustic Charm. Therefore, town A will maintain a level of Rustic Charm slightly off its ideal level

of Rustic Charm, but still not exactly equal to that value in order to attract more residents. This is because the utility derived from maintaining a level of Rustic Charm close to the town's ideal level of Rustic Charm is greater than the utility derived from gaining residents. So, when λ is small, towns will change their level of Rustic Charm close enough to .5 so as to gain as many residents as possible, without changing it so much as to cause the overall utility to decrease due to the difference between a and a*. This stringency level of zoning law at which town A will then rest is where the marginal cost of deviating from the ideal level of zoning law equals the marginal benefit of the additional residents town A gains from changing its zoning laws to more closely match the preferences of the indifferent person. If town A moves its level of Rustic Charm farther towards .5 from this ideal point, then while it will gain more residents, its overall utility will decrease. Thus, town A will not maintain a level of Rustic Charm farther towards .5 than this ideal point.

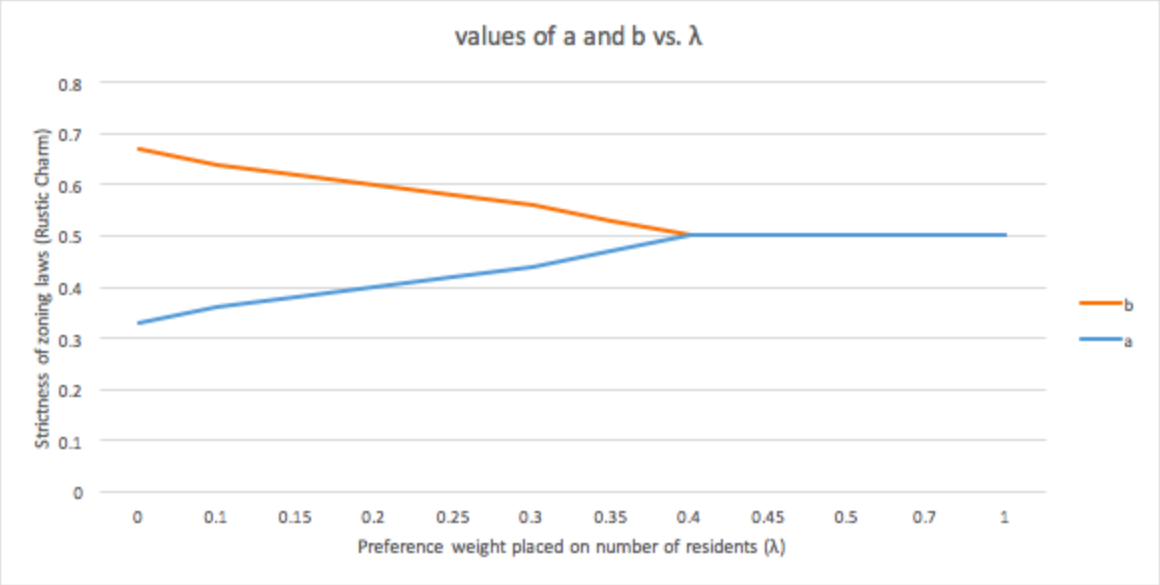
II. As λ grows larger, $(1-\lambda)$ grows smaller. Thus, the town slowly derives a greater amount of utility from gaining residents and a lesser amount of utility from its level of Rustic Charm. As a result, town B will decrease its level of Rustic Charm and town A will increase its level of Rustic Charm. This is because $(½)*((a^2 - b^2 - e)/(a - b)) = \triangledown$: by decreasing its level of Rustic Charm, b, town B is decreasing the value of $\triangledown$, thus gaining more residents. Similarly, increasing its level of Rustic Charm leads to a increase in $\triangledown$, thus, by increasing its level of Rustic Charm, town A is gaining more residents. All of the residents with an ideal level of Rustic Charm, v, such that $v \geq \triangledown$ will pick town B over town A because town B will provide for them a greater utility than town A. Similarly, all of the residents with an ideal level of Rustic Charm, v, such that $v \leq \triangledown$ will pick town A over town B, because town A will provide for them a greater utility than town B. Once λ is large enough, the town derives more utility from gaining residents than it does from maintaining a level of Rustic Charm close to its ideal level of Rustic Charm. Looking again at the utility function of town A: $Ua = (Na)*(\lambda) - (1-\lambda)*(a^*-a)^2$, the $(Na)*(\lambda)$ (utility from gaining residents) portion of the equation provides more utility to the town than does the $- (1-\lambda)*(a^*-a)^2$ (utility from a more

ideal Rustic Charm) portion of the equation. In this case, the Nash Equilibrium is similar to Subcase 3, where towns only care about gaining residents. Both towns will maintain a level of Rustic Charm at a=b=.5, and each town will get a half of the residents. This is because the cost of from the Rustic Charm deviation is so small relative to the utility gained from the increase in residents that it is of the greatest utility to the town to maximize strictly the part of its utility relating to gaining residents.

The chart and table below display these results. When λ is small, the values of a and b move somewhat closer to .5, but are held back by the cost due to the deviation in Rustic Charm. When λ gets large enough (in this case, at .4), the values of a and b both rest at .5. This means that, similar to Subcase 3, both towns are at a level of Rustic Charm halfway between the least restrictive zoning laws and the most stringent zoning laws.

a*	**b***	**λ**	**e**	**a**	**b**
1/3	2/3	0	0	0.33	0.67
1/3	2/3	0.1	0	0.36	0.64
1/3	2/3	0.15	0	0.38	0.62
1/3	2/3	0.2	0	0.4	0.6
1/3	2/3	0.25	0	0.42	0.58
1/3	2/3	0.3	0	0.44	0.56
1/3	2/3	0.35	0	0.47	0.53

1/3	2/3	0.4	0	0.5	0.5
1/3	2/3	0.45	0	0.5	0.5
1/3	2/3	0.5	0	0.5	0.5
1/3	2/3	0.7	0	0.5	0.5
1/3	2/3	1	0	0.5	0.5



5. Main Result: **λ=.1, e>0**

In this case, town A and town B place a small weight on the number of residents who live within its borders (1/10), with a much greater weight (9/10) from maintaining a level of Rustic Charm close to their ideal level. Towns benefit more from maintaining a level of Rustic Charm close to their ideal level than they do gaining more residents. Town A also has a distance advantage, which means that town A shares a border with the Cape Cod Canal, while town B does not. Town B is farther away from the Cape Cod Canal than town A. Because of the distance advantage of town A, town A will always get all of the residents when town A and town B have the same level of Rustic Charm. Therefore, in order to entice

residents to go to town B, town B will be incentivized to maintain a level of Rustic Charm different than the level of Rustic Charm of town A.

For this case, the Nash Equilibrium is different when town A's distance advantage is small versus when town A's distance advantage is large. When town A's distance advantage is small and town B is close to the border, then the Nash Equilibrium is the point where both town A and town B increase their Rustic Charm so that their level of Rustic Charm is greater than their ideal level of Rustic Charm; town A and town B's zoning laws are more stringent than they would ideally prefer. This result proves that when town A is closer to the Cape Cod Canal than town B, town B will increase its level of Rustic Charm to provide an increased incentive for residents to invest the extra time and money to go to town B instead of town A.

When town A's distance advantage is large enough, then there is no level of Rustic Charm at which town B will be able to entice any residents to go to town B. No matter how stringent town B's zoning laws, town A has a great enough distance advantage so that town A will still get all of the residents. Town A will provide the greater benefit for every resident. Because it is impossible for town B to get any residents, there is no incentive for town B to have any other level of Rustic Charm other than its ideal level. It will not gain any benefit from additional residents, it will only be forced to pay the cost resulting from having zoning laws stricter than ideal. Because town A has a great enough distance advantage that it will gain all of the residents no matter the Rustic Charm of town B, there is no incentive for town A to maintain a level of Rustic Charm different from its ideal level of Rustic Charm (its ideal level of stringency regarding its zoning laws). Therefore, both town A and town B will both maintain a level of Rustic Charm of $a=a^*$ and $b=b^*$.

Proposition: In this case:

I. When the distance advantage of town A, e, is small, then there is a Nash Equilibrium where town A and town B slightly increase their level of Rustic Charm.

II. When the distance of advantage of town A, e, is large, then there is a Nash Equilibrium where town A and town B maintain each their ideal level of Rustic Charm (a=a* and b=b*).

III. When the distance advantage of town A, e, is not an extreme value, then there is no Nash Equilibrium.

Proof:

I. Assume that town A and town B both start at their ideal levels of Rustic Charm, and that the distance advantage of town A is small. The utility function of town A is $Ua = (Na)*(\lambda) - (1-\lambda)*(a*-a)^2$, and the utility function for town B is $Ub = (Nb)*(\lambda) - (1-\lambda)*(b*-b)^2$. Because both towns are starting from their ideal level of Rustic Charm, for town A, at a=a* and for town B, at b=b*, this means that for both Ua and Ub the second term in the equation is zero.

Town A will slightly increase its level of Rustic Charm in attempt to capture some of town B's people. Looking at the utility function, this means that now, $|(1-\lambda)*(a*-a)^2| > 0$ because town A now has more stringent zoning laws than it would ideally choose. Despite this, town A will still have a positive increase in utility as a result of this change in Rustic Charm because of its distance advantage, e. Town B will also increase its level of Rustic Charm so that it can better compete with town A for people; however, town B also cannot increase its level of Rustic Charm indefinitely for the same reason as described in Subcase 4. Town B will only increase its level of Rustic Charm as long as the marginal benefit of doing so is greater than the marginal cost of deviating farther from its ideal level of Rustic Charm.

As the distance advantage of town A increases, town B is farther from the Cape Cod Canal than town A, which remains against the border of the Canal. In the utility function for town B, $Ub = (Nb)*(\lambda) - (1-\lambda)*(b*-b)^2$, the value of e is increasing. The utility for town B decreases at every possible value of b, making it necessary for town B to increase its value of Rustic Charm to a greater level in attempt to compensate for the increase in distance disadvantage. Additionally, an increased value of e (increased distance advantage) means that town A will increase its value of Rustic Charm to a greater level compared to when e was at a smaller value and not suffer a loss of utility, despite that $|(1-\lambda)*(a*-a)^2|$ is

now at a greater value. The distance advantage of town A and the greater number of residents compensate for the negative effect of the more stringent zoning laws.

II. When the distance advantage of town A is large, it is not possible for town B to get any residents. The travel distance to reach town B is so large that no matter how stringent town B's zoning laws are, no person will find greater benefit traveling to town B instead of town A. For any level of Rustic Charm for town B, town A provides the greater utility to any person: $e - (a - v)^2 > - (b - v)^2$ for any value of v.

Because it is impossible for town B to get any residents in their town, given that $Ub = (Nb)*(\lambda) - (1-\lambda)*(b*-b)^2$, the only point at which town B should rest in this point is at the point b=b*. If town B were to pick any other point besides b=b*, it would not gain any residents and would have a negative utility resulting from the differential comparing b to b*. Therefore, town B will have a level of b=b*.

For any value of Rustic Charm, town A will get all of the residents. For any value of v, where $0 \leq v \leq 1$, the payoff to live in town A is greater than the payoff to live in town B. Therefore, to maximize its utility, town A will choose the level of Rustic Charm a=a*. When a=a*, $(1-\lambda)*(a*-a)^2 = 0$. If town A picks any other level of Rustic Charm, $|(1-\lambda)*(a*-a)^2| > 0$, then town A's utility would decrease by the value of $(1-\lambda)*(a*-a)^2$. Therefore, town A will have a level of Rustic Charm of a=a*.

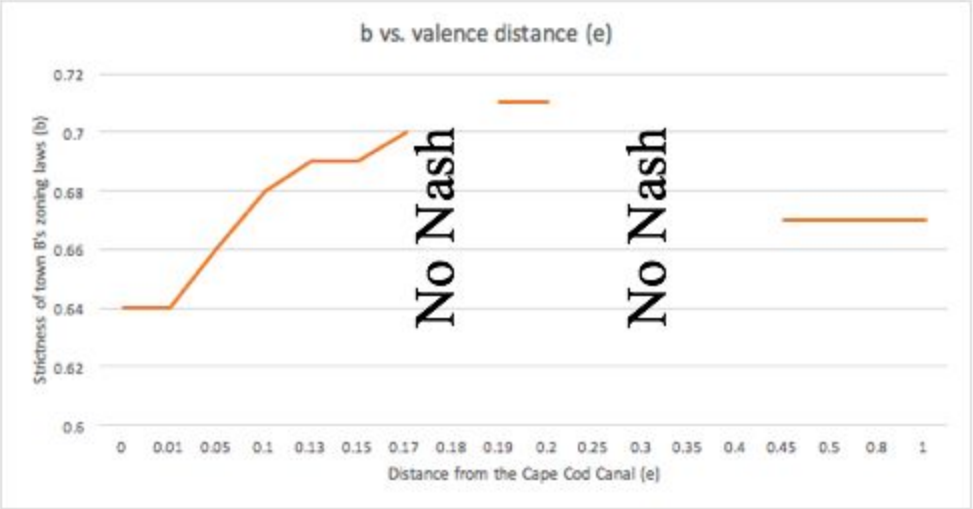
III. When e is neither very large nor very small and λ remains at .1, there is no Nash Equilibrium. This follows from parts I and II. Let both town A and town B start at their ideal levels of Rustic Charm: town A's level of Rustic Charm is a=a*, town B's level of Rustic Charm is b=b*. Because town A has a distance advantage, by reasoning in part I, town A will shift its level of Rustic Charm towards town B, and town B will shift away from town A. This shift of town B will again by part I lead town A to again shift its level of Rustic Charm towards town B's level of Rustic Charm. There is never a case where neither town would like to shift its level of Rustic Charm.

These results are displayed in the chart and table below. As the distance advantage of town A increases, the value of Rustic Charm for town A and the value of Rustic Charm for town B (the value of a and b) both increase. As town B gets farther from the Cape Cod Canal compared to town A, town B increases its Rustic Charm beyond its ideal level so that it can better compete with town A. Town B must compensate for town A's distance advantage by increasing its level of Rustic Charm, providing people an incentive to travel extra distance to reach town B over the closer town A. Thus, distance does influence a town's choice of zoning law. Without considering any other factors between two different towns on Cape Cod besides their distance from the Cape Cod Canal, it is known that the town that is farther away from the Cape Cod Canal must have more stringent zoning laws than it would in that case that it was closer to the Cape Cod Canal, in order to attract residents. More specifically, as distance increases in a town, zoning laws become more stringent in attempt to provide for people an increased incentive to travel extra distance to reach the town. The more stringent zoning laws increase the town's level of Rustic Charm: the more stringent the zoning laws, the more Rustic Charm (quaintness, historical Cape Cod style) a town embodies.

These results are shown in the table and graph below. The values in the columns labeled "a" and "b" are the Nash Equilibrium levels of Rustic Charm for each case. As the "e" column increases, the values of a and b also increase, indicating the increased effect of town A's distance advantage, and as a result the increased need for town B to provide a greater incentive for people to travel to town B rather than the closer town, town A.

a*	**b***	**λ**	**e**	**a**	**b**
1/3	2/3	0.1	0	0.36	0.64
1/3	2/3	0.1	0.01	0.36	0.64

1/3	2/3	0.1	0.05	0.38	0.66
1/3	2/3	0.1	0.1	0.4	0.68
1/3	2/3	0.1	0.13	0.41	0.69
1/3	2/3	0.1	0.15	0.42	0.69
1/3	2/3	0.1	0.17	0.42	0.7
1/3	2/3	0.1	0.18	No Nash Equilibrium	No Nash Equilibrium
1/3	2/3	0.1	0.19	0.43	0.71
1/3	2/3	0.1	0.2	0.43	0.71
1/3	2/3	0.1	0.25	No Nash Equilibrium	No Nash Equilibrium
1/3	2/3	0.1	0.3	No Nash Equilibrium	No Nash Equilibrium
1/3	2/3	0.1	0.35	No Nash Equilibrium	No Nash Equilibrium
1/3	2/3	0.1	0.4	No Nash Equilibrium	No Nash Equilibrium
1/3	2/3	0.1	0.45	0.33	0.67
1/3	2/3	0.1	0.5	0.33	0.67
1/3	2/3	0.1	0.8	0.33	0.67
1/3	2/3	0.1	1	0.33	0.67



Conclusions:

In this theoretical model of town competition, I have shown that The geographical location of a town on Cape Cod affects the town's optimal choice of zoning laws and therefore beauty. As a town moves farther up the Cape and further away from the Cape Cod Canal, it must provide a resident a reason to travel further and pick the more distant town over towns closer to the Canal which require less time and money to reach. This incentive is provided when the distant town makes itself more quaint or "rustic". This entices more residents to come to the town; however, there is a cost of lesser convenience the town bears as a result. A town which is stringent with development becomes more difficult to live in because of the developmental limits resulting from this stringency. These limits are meant to preserve the historical nature of the town but they also serve to make living in the town less convenient.

The most significant result derived from the model is the main result: As town B moves farther away from the Cape Cod Canal, town B is forced to increase its level of Rustic Charm in order to compete with town A for people. This result explains the differences in appearance comparing towns farther versus closer to the Cape Cod Canal. On Cape Cod, towns which require more time and effort to reach (those

which are farther away), must compensate for this disadvantage by making themselves more attractive in the form of being more “rustic”.

This result is analogous to the result of Groseclose (2010). Groseclose finds that in the case of an election, the advantaged candidate will adopt a more moderate platform than the disadvantaged candidate, who will adopt a more extreme platform. This is to better compete with the advantaged candidate. In the case of this paper, as the town A gains a greater distance advantaged relative to town B, (as the distance from the Cape Cod Canal to town B increases), town B will maintain a stricter level of Rustic Charm to compete with town A.

It is important to ask whether or not this relationship I plan to model actually exists in real life. I emailed town officials of these different Cape Cod towns asking them if they actually do compete with other Cape Cod towns and, if they do, how? Specifically, the questions I asked each individual were: 1) what policies do Cape Cod towns use to entice people to purchase vacation homes in your area? 2) How aggressively do these towns court these potential homebuyers? 3) Which towns in Cape Cod are the most aggressive in trying to attract people to buy vacation homes? 4) How are they more aggressive? Reaching out to these officials I hoped to learn some of the motivation behind Cape Cod towns’s zoning policies, so that I could determine whether or not the model I was going to create would be applicable to the real world.

The responses I received made it was clear that Cape Cod towns do enforce policies meant to influence their population. For example, Provincetown has a residential tax exemption for full time residents. A Wellfleet town official stated that Wellfleet is “concerned with putting the brakes on” the second homeowner market because “we are a small town without the resources”. The Chief of Staff of the Cape Cod Commission reported that she believes Cape towns create policies meant to “preserve and enhance our natural environment and community life”. She believes that Cape towns, in general, work to

“create more housing opportunities for average wage earners”, and at the same time recognize that “the second homeowner [market] is a very powerful market that has not required policy invention to sustain.”

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